IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellant:	Raymond H. Kraft	Examiner: John W. Lee
Serial No.:	10/800,420	Group Art Unit: 2624
Filed:	March 12, 2004	Docket No.: A126.253.102 / 076111-0308723
Due Date:	**June 4, 2011**	
Title:	SYSTEM AND METHOD OF NON-LINEAR GRID FITTING AND COORDINATE SYSTEM MAPPING	

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This Appeal Brief is submitted in support of the Notice of Appeal filed on April 4, 2011, appealing the final rejection of claims 1-7, 16-20 and 29-39 of the above-identified application as set forth in the Final Office Action mailed January 4, 2011.

The U.S. Patent and Trademark Office is hereby authorized to charge Deposit Account No. 50-0471 in the amount of $540.00 for filing a Brief in Support of an Appeal as set forth under 37 C.F.R. § 41.20(b)(2). At any time during the pendency of this application, please charge any required fees or credit any overpayment to Deposit Account No. 50-0471.

Appellant respectfully requests consideration and reversal of the Examiner's rejection of pending claims 1-39.

TABLE OF CONTENTS

REAL PARTY IN INTEREST

The intellectual property embodied in the pending application is assigned to Rudolph Technologies, Inc.

RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellant that will have a bearing on the Board's decision in the present Appeal.

STATUS OF CLAIMS

In a Final Office Action mailed January 4, 2011, claims 1-7, 16-20 and 29-39 were finally rejected. Claims 8-15 and 21-28 have been withdrawn. Claims 8-15 and 21-28 have been canceled. Claims 1-39 are pending in the application. Claims 1-7, 16-20 and 29-39 are the subject of the present Appeal.

Claims 16-20 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Claims 1-2, 4, 6, 30, 32, 34 and 36-39 are rejected under 35 U.S.C. 102(b) as being anticipated by Michael et al., U.S. Patent No. 5,768,443 ("Michael").

Claims 3, 16-19 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Thompson, U.S. Patent No. 5,020,123 ("Thompson").

Claims 5 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Macy et al., U.S. Patent No. 6,538,691 ("Macy").

Claims 7 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Leonard et al., U.S. Patent No. 7,034,272 B1 ("Leonard").

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Thompson in view of Macy.

STATUS OF AMENDMENTS

No amendments have been entered subsequent to the Final Office Action mailed January 4, 2011. The claims listed in the Claims Appendix, therefore, reflect the claims as of April 4,

2011.

SUMMARY OF THE CLAIMED SUBJECT MATTER

One aspect of the present invention, as claimed in independent claim 1, provides a method of fitting acquired fiducial data to a set of fiducials on a fiducial plate. *See p. 4, l. 20-p. 5, l. 5.* The method includes fitting a fiducial grid model to data acquired by an imaging apparatus captured such that features are positioned in space relative to the fiducial plate and conversion from acquired coordinates to ideal fiducial coordinates using a data processing component. *See p. 2, ll. 18-25 and p. 5, l. 15-p. 6, l. 2.* The method further includes calculating an absolute location for each identified acquired image feature centers relative to the fiducial plate in fiducial plate coordinates using the data processing component. The absolute location indicates a distance measurement in fiducial plate coordinates. Based on at least one calculated absolute location of the identified acquired image feature centers, a structure represented by the identified acquired image feature center is selectively modified.

Another aspect of the present invention, as claimed in independent claim 16, provides a computer readable medium encoded with non-transitory data and instructions for fitting acquired fiducial data to a set of fiducials on a fiducial plate. The data and instructions cause an apparatus executing the instructions to fit a fiducial grid model to data acquired by an imaging apparatus captured such that features are positioned in space relative to the fiducial plate. *See p. 3, ll. 21-27.* A conversion is established from acquired coordinates of each identified fiducial to ideal plate coordinates and an absolute location of identified acquired image feature centers relative to the fiducial plate is calculated. The absolute location indicating a distance measurement in fiducial plate coordinates.

Another aspect of the present invention, as claimed in independent claim 29, provides a method of accurately identifying a location of a feature relative to a fiducial plate. The method includes acquiring an image of an object with an imaging apparatus, the image comprising data concerning the position of a plurality of fiducial marks on a fiducial plate and data concerning the position of a feature of the object. The image is acquired such that the data concerning the position of a plurality of fiducial marks on a fiducial plate and data concerning the position of a

feature of the object is obtained simultaneously. A fiducial grid model is fit to the image data to establish a conversion from coordinates of the plurality of fiducial marks acquired from the image to coordinates of the plurality of fiducial marks on the fiducial plate using a data processing component. An absolute location of a center of each of the plurality of fiducial marks is calculated in the acquired image relative to the fiducial plate in fiducial plate coordinates using the data processing component. The absolute location indicates a distance measurement in fiducial plate coordinates. A position of a feature of the object in the acquired image is determined and the determined position is modified based on at least one calculated absolute location of the plurality of fiducial marks in the acquired image. *See p. 2, ll. 18-27.*

Yet another aspect of the present invention, as claimed in independent claim 37, provides a method of localizing an object. The method includes acquiring an image with an imaging apparatus. The image includes the object to be localized and a plurality of fiducial marks. A model is fit to the plurality of fiducial marks that defines a transformation between a location of the plurality of fiducial marks as seen in the image and an actual location of the plurality of fiducial marks. An actual position of the object is determined with respect to the plurality of fiducial marks using the model fitted to the image of the plurality of fiducial marks. *See p. 2, ll. 18-27.*

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

I. Appellant seeks review of the rejection of claims 16-20 rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

II. Appellant seeks review of the rejection of claims 1-2, 4, 6, 30, 32, 34 and 36-39 rejected under 35 U.S.C. 102(b) as being anticipated by Michael et al., U.S. Patent No. 5,768,443 ("Michael").

III. Appellant seeks review of the rejection of claims 3, 16-19 and 31 rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Thompson, U.S. Patent No. 5,020,123 ("Thompson").

IV. Appellant seeks review of the rejection of claims 5 and 33 rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Macy et al., U.S. Patent No. 6,538,691 ("Macy").

V. Appellant seeks review of the rejection of claims 7 and 35 rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Leonard et al., U.S. Patent No. 7,034,272 B1 ("Leonard").

VI. Appellant seeks review of the rejection of claim 20 rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Thompson in view of Macy.

ARGUMENT

I. The Applicable Law

Under 35 U.S.C. § 101, patents are to be granted only for "any new and useful process, machine, or composition of matter, or any new and useful improvement thereof."

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993).

Patent examiners carry the responsibility of making sure that the standard of patentability enunciated by the Supreme Court and by the Congress is applied in each and every case. *MPEP §2141.* The examiner bears the burden under 35 U.S.C. §103 in establishing a *prima facie* case of obviousness. *In re Fine*, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). "Rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead there must be some articulated reasoning with some additional rational underpinning to support the legal conclusion of obviousness." *KSR Int'l Co. v. Teleflex, Inc.*, 550 USPQ2d 1385, 1396 (U.S. 2007); *In re Khan*, 78 USPQ2d 1329 (Fed. Cir. 2006). In this regard, identification of a teaching, suggestion,

or motivation for modifying a reference or combination of the teachings of multiple references provides helpful insight. *KSR* at 1396. "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Leapfrog Enterprises, Inc. v. Fischer-Price, Inc.*, 82 USPQ2d 1687, 1690-1691 (Fed. Cir. 2007). A prior patent cited as a §103 reference must be considered in its entirety, "i.e., as a whole, including portions that lead away from the invention." *Panduit Corp. v. Dennison Mfg. Co.*, 1 USPQ2d 1593, 1597 (Fed. Cir. 1987). That is, the examiner must recognize and consider not only the similarities, but also the critical differences between the claimed invention and the prior art as one of the inquiries pertinent to any obvious inquiry under 35 U.S.C. §103. *In re Bond*, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990).

II. Rejection of Claims 16-20 under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

On page 3, the Office Action notes that adding the limitation "non-transitory" to the claim will avoid a rejection under 35 U.S.C. § 101. Claim 16 recites non-transitory data and instructions and, as such, is not intended to cover forms of carrier waves and transitory propagating signals. Thus, claims 16-20 meet the requirements of 35 U.S.C. § 101 and thus this rejection should be reversed.

III. Rejection of Claims 1-2, 4, 6, 30, 32, 34 and 36-39 under 35 U.S.C. 102(b) as being anticipated by Michael.

It is submitted that Michael does not anticipate the above identified claims for at least the following reasons: Michael does not describe or suggest, explicitly or implicitly, that fiducial marks or features will be used, at all times and, Michael requires the use of more than one imaging apparatus or camera.

Michael describes a calibration process whereby *multiple* cameras are calibrated, the one to the other, to ensure the proper orientation and positioning of the fields of view of the *multiple* cameras. At a minimum, Michael appears to teach that their system is only required where a

user is faced with the task of accurately positioning multiple cameras, each having its own field of view. Accordingly, Michael fails to teach as claimed only a single imaging apparatus.

In particular, Michael explicitly states that the calibration target, which may include fiducial marks, is to be used only during a calibration phase. Their invention, which is a method of image correction, explicitly omits the use of a calibration target during run time. As such, no conversion from acquired coordinates to ideal fiducial coordinates is disclosed. Instead, the transformation of Michael is from acquired coordinates from one camera to physical coordinates of a calibration target, which does not constitute a conversion to ideal fiducial coordinates. Conversely, the present invention uses fiducial marks during run time to calculate an absolute location based on the conversion. For the foregoing reasons, it is submitted that claims 1 is patentable over the Michael reference.

With regard to independent claims 29 and 37, it is respectfully submitted that these claims are allowable at least for the reasons provided above. Moreover, as is mentioned in the background of the invention of the present application, in some instances the accuracy and precision required and metrology operation that uses imaging techniques to obtain object position exceeds the accuracy and position that can be provided using encoder positioning technology and standard, uncorrected images of the objects under test. The applicant does not contend that its methodologies represent a first instance or occurrence of the type of calibration that is described in the Michael reference cited by the examiner. Rather, it is submitted that the applicant's invention, which is drawn to the use of fiducial marks that are included in each captured image to assist in locating objects in an image relative to the real world coordinate system defined by the fiducial marks that is both novel and nonobvious. In simple terms, the invention may be described as a method for correcting a captured image to remove optical distortion and other artifacts. However, the context for this invention goes a bit beyond simple it image error correction in that the claimed image correction is done for the purpose of ensuring that when one identifies a position of an object in a captured image, that the correction factors obtained may be used to determine an actual location of the object in the coordinate system defined by the fiducial marks. As such, independent claims 29 and 37 are also allowable.

Additionally, the conversion in Michael is not performed based on position of an object and fiducial plate being captured simultaneously as otherwise required in claim 29 and 37.

Claims 2, 4, 6, 30, 32, 34, 36 and 38-39 are allowable at least based on their relationship to their respective independent claims.

IV. Rejection of Claims 3, 16-19 and 31 under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Thompson.

It is submitted that claims 3 and 16-19 are patentable over the combination of Michael in view of Thompson for at least those reasons given above. Moreover, Appellants submit that there is no motivation to utilize the distortion correction map of Michael with a selective iterative process as recited in claims 3, 16-19 and 31. The calibration process of Michael is only concerned with correcting distortion from a field of view and is not concerned with identifying objects during run time or moreover selection of particular data points in calculating an absolute location of identified acquired image feature centers. In an unrelated manner, Thompson is concerned with fax images and does not disclose selective iteration for calculating image feature centers relative to a fiducial. Furthermore, the "selection" in Thompson is compared to other predetermined markings and completely unassociated with position calculation. For at least these further reasons, claims 3, 16-19 and 31 are allowable.

V. Rejection of Claims 5 and 33 under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Macy.

It is submitted that claims 5 and 33 are patentable over Michael in view of Macy for at least those reasons given above. In addition, as Michael is only concerned with calibration of field of views for separate cameras, no disclosure or motivation exists for utilizing a fiducial grid or assuming that rotation of an imaging apparatus with respect the grid is negligible. Michael only discloses the transformation of coordinates independent of any image feature centers relative to a grid or calculating a position of the image feature centers. Macy discloses a grid for purposes of correcting distortion, but is completely unrelated to calculating an absolute position. As such, claims 5 and 33 are further believed to be allowable.

VI. Rejection of Claims 7 and 35 rejected under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Leonard.

It is submitted that claims 7 and 35 are patentable over Michael in view of Leonard for at least those reasons given above.

VII. Rejection of Claim 20 under 35 U.S.C. 103(a) as being unpatentable over Michael in view of Thompson in view of Macy.

It is submitted that claim 20 is patentable over Michael in view of Thompson in view of Macy for at least those reasons given above. Moreover, Appellants submit that there is no motivation to utilize the distortion correction map of Michael with a selective iterative process. The calibration process of Michael is only concerned with correcting distortion from a field of view and is not concerned with identifying objects during run time or moreover selection of particular data points in calculating an absolute location of identified acquired image feature centers. In an unrelated manner, Thompson is concerned with fax images and does not disclose selective iteration for calculating image feature centers relative to a fiducial. Furthermore, the "selection" in Thompson is compared to other predetermined markings and completely unassociated with position calculation. In addition, as Michael is only concerned with calibration of field of views for separate cameras, no disclosure or motivation exists for utilizing a fiducial grid or assuming that rotation of an imaging apparatus with respect the grid is negligible. Michael only discloses the transformation of coordinates independent of any image feature centers relative to a grid or calculating a position of the image feature centers. Macy discloses a grid for purposes of correcting distortion, but is completely unrelated to calculating an absolute position. As such, claims 20 is further believed to be allowable.

CONCLUSION

For the above reasons, Appellant respectfully submits that the art of record neither anticipates nor renders obvious the claimed invention. Thus, the claimed invention does patentably distinguish over the art of record. Appellant, therefore, respectfully submits that the above rejections are not correct and should be withdrawn, and respectfully requests that the Examiner be reversed and that all pending claims be allowed.

The Examiner is invited to contact the Applicant's representative at the below-listed telephone numbers to facilitate prosecution of this application.

Any inquiry regarding this Amendment and Response should be directed to Todd R. Fronek at Telephone No. (612) 767-2522, Facsimile No. (612) 573-2005. In addition, all correspondence should continue to be directed to the following address:

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Respectfully submitted,
Raymond H. Kraft,
By his attorneys,

Date: 6/6/11
TRF:skh

/Todd R. Fronek/
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CLAIMS APPENDIX

1.(Previously Presented) A method of fitting acquired fiducial data to a set of fiducials on a fiducial plate; said method comprising:

fitting a fiducial grid model to data acquired by an imaging apparatus captured such that features are positioned in space relative to the fiducial plate;

establishing a conversion from acquired coordinates to ideal fiducial coordinates using a data processing component;

calculating an absolute location for each identified acquired image feature centers relative to the fiducial plate in fiducial plate coordinates using the data processing component, the absolute location indicating a distance measurement in fiducial plate coordinates; and

based on at least one calculated absolute location of the identified acquired image feature centers, selectively modifying a structure represented by the identified acquired image feature center.

2.(Previously Presented) The method of claim 1 wherein said fitting comprises identifying fiducial coordinates for each fiducial captured in said data acquired by said imaging apparatus.

3.(Original) The method of claim 2 further comprising selectively iterating said identifying coordinates for each fiducial and said calculating an absolute location of identified acquired image feature centers.

4.(Original) The method of claim 1 wherein said calculating comprises utilizing a linear least squares operation.

5.(Original) The method of claim 1 further comprising assuming that a rotation of said imaging apparatus relative to a fiducial grid is negligible.

6.(Original) The method of claim 1 wherein said imaging apparatus comprises a charge-coupled device camera.

7.(Original) The method of claim 1 wherein said imaging apparatus comprises a complementary metal-oxide semiconductor device.

8. – 15.(Cancelled)

16.(Previously Presented) A computer readable medium encoded with non-transitory data and instructions for fitting acquired fiducial data to a set of fiducials on a fiducial plate; said data and said instructions causing an apparatus executing said instructions to:

fit a fiducial grid model to data acquired by an imaging apparatus captured such that features are positioned in space relative to the fiducial plate;

establish a conversion from acquired coordinates of each identified fiducial to ideal plate coordinates; and

calculate an absolute location of identified acquired image feature centers relative to the fiducial plate, the absolute location indicating a distance measurement in fiducial plate coordinates.

17.(Original) The computer readable medium of claim 16 further encoded with data and instructions; said data and said instructions further causing an apparatus executing said instructions to identify fiducial coordinates for each fiducial captured in said data acquired by said imaging apparatus.

18.(Original) The computer readable medium of claim 17 further encoded with data and instructions; said data and said instructions further causing an apparatus executing said instructions selectively to iterate identifying coordinates for each fiducial and calculating an absolute location of identified acquired image feature centers.

19.(Original) The computer readable medium of claim 16 further encoded with data and instructions; said data and said instructions further causing an apparatus executing said instructions to utilize a linear least squares operation.

20.(Original) The computer readable medium of claim 16 further encoded with data and instructions; said data and said instructions further causing an apparatus executing said instructions to assume that a rotation of said imaging apparatus relative to a fiducial grid is negligible.

21. – 28.(Cancelled)

29.(Previously Presented) A method of accurately identifying a location of a feature relative to a fiducial plate comprising:

acquiring an image of an object with an imaging apparatus, the image comprising data concerning the position of a plurality of fiducial marks on a fiducial plate and data concerning the position of a feature of the object, the image being acquired such that the data concerning the position of a plurality of fiducial marks on a fiducial plate and data concerning the position of a feature of the object is obtained simultaneously;

fitting a fiducial grid model to the image data to establish a conversion from coordinates of the plurality of fiducial marks acquired from the image to coordinates of the plurality of fiducial marks on the fiducial plate using a data processing component;

calculating an absolute location of a center of each of the plurality of fiducial marks in the acquired image relative to the fiducial plate in fiducial plate coordinates using the data processing component, the absolute location indicating a distance measurement in fiducial plate coordinates; and,

determining a position of a feature of the object in the acquired image and modifying the determined position based on at least one calculated absolute location of the plurality of fiducial marks in the acquired image.

30.(Previously Presented) The method of claim 29 wherein the fitting comprises identifying fiducial mark coordinates for each fiducial mark captured in the image data acquired by the imaging apparatus.

31.(Previously Presented) The method of claim 30 further comprising selectively iterating the identifying coordinates for each fiducial mark and the calculating an absolute location of identified acquired image feature centers.

32.(Previously Presented) The method of claim 29 wherein the calculating comprises utilizing a linear least squares operation.

33.(Previously Presented) The method of claim 29 further comprising assuming that a rotation of the imaging apparatus relative to the fiducial plate is negligible.

34.(Previously Presented) The method of claim 29 wherein the imaging apparatus comprises a charge coupled device camera.

35.(Previously Presented) The method of claim 29 wherein the imaging apparatus comprises a complementary metal-oxide semiconductor device.

36.(Previously Presented) The method of claim 29 wherein the object is part of a semiconductor probe card.

37.(Previously Presented) A method of localizing an object, comprising:

acquiring an image with an imaging apparatus, the image including the object to be localized and a plurality of fiducial marks;

fitting a model to the plurality of fiducial marks that defines a transformation between a location of the plurality of fiducial marks as seen in the image and an actual location of the plurality of fiducial marks;

determining an actual position of the object with respect to the plurality of fiducial marks using the model fitted to the image of the plurality of fiducial marks.

38.(Previously Presented) The method of claim 37 further comprising:

interposing a substantially transparent substrate having a plurality of fiducials formed therein between the imaging apparatus and the object.

39.(Previously Presented) The method of claim 37 further comprising:

acquiring a succession of images with an imaging apparatus, each of the succession of images including both the object and the plurality of fiducial marks.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.